k.e. & g.p.e.

Name & Set

1 A motorcar of mass 1200kg is moving with a velocity of 20m/s.

(a) How much kinetic energy does it have?

_____

_____ [2]

(b) What happens to this energy when it is slowed to rest by applying the brakes?

_____

_____ [2]

2 A bullet fired from a rifle travels at 400 m/s.

(a) Calculate the kinetic energy of the bullet if its mass of the bullet is 5 grams.

_____

_____ [2]

(b) Does the kinetic energy of the bullet remain constant as it travels through the air? Explain your answer.

_____

_____

_____ [2]

3 A car of mass 800kg moves at 15 metres per second.

(a) Calculate its kinetic energy.

_____

_____ [2]

(b) Calculate its kinetic energy if the speed of the car doubles.

_____

_____ [2]

(c) Calculate its velocity if its initial kinetic energy is doubled.

_____

_____

_____ [2]

4 A steel ball of mass 0.1kg falls from a height of 1.8 metres onto a hard surface and rebounds to a height of 1.2 metres.

Calculate:

(a) the g.p.e. of the ball before it fell.

_____

_____ [2]

(b) the k.e. of the ball at the instant it reached the surface.

_____

_____ [2]

(c) the velocity with which it hit the surface.

_____

_____ [2]

(d) the k.e. with which the ball bounces from the surface.

_____

_____ [2]

(e) Explain why there is a loss of kinetic energy when the ball bounces and what happens to the energy that is lost.

_____

_____ [2]

5 (a) To what height must a brick, mass 2.5kg, be raised to give it a g.p.e. of 100 Joules?

_____

_____ [2]

(b) To what height must it be raised to double its potential energy?

_____

_____ [2]

6 (a) What is the velocity of a ball, mass 0.25 kg, if it has 100 Joules of kinetic energy?

_____

_____ [2]

(b) What will its velocity be if its kinetic energy is doubled?

_____

_____ [2]

(c) What will be its kinetic energy if its velocity is doubled?

_____

_____ [2]

7 Figure 1 shows a roller coaster. The carriage is hauled up the incline from grounds level at A to the highest point point above the ground, B. It then rolls freely (i.e. no driving force, just the pull of gravity) back down to ground level at C.

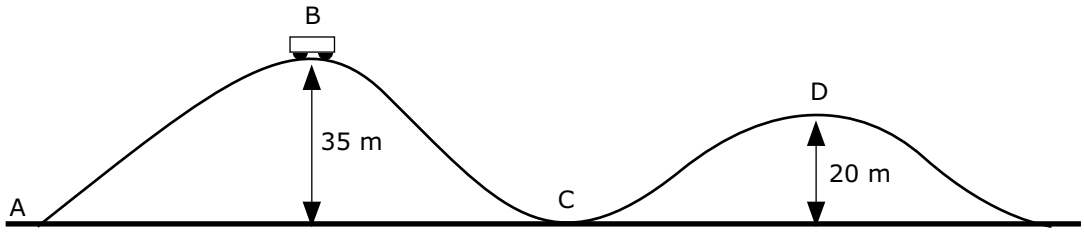


Fig. 1

(i) Into what form of energy is the g.p.e of the carriage converted as it rolls from B to C?

_____ [1]

(ii) Assuming it starts from rest at B, how fast would the carriage be travelling when it reaches if no friction forces acted on it?

_____

_____ [2]

(iii) On reaching C the carriage continues moving the next slope to the point D. Explain why D can't be as high as B if the carriage rools freely.

_____

_____ [2]

(iv) How much energy has the carriage lost in rolling from B to D.

_____

_____ [2]

8 A plane of mass 75000kg is flying at 250m/s (about 550mph). It is at a height of 10000m.

(a) How much energy in total (g.p.e. and k.e.) does the plane have (relative to the ground)?

_____

_____ [2]

(b) What is the source of the plane's energy?

_____ [2]

(c) Draw a free-body diagram for the plane in flight.

_____ [2]

9 A pole vaulter of mass 75kg reaches a maximum velocity of 5m/s just before he jams his pole into the slot. Assuming that 60% of his kinetic energy can be converted into gravitational potential energy, calculate the maximum height by which he can raise his centre of gravity.

_____

_____

_____

_____ [2]

10 An express lift takes a 70kg passenger from street level to the top of a 400m high skyscraper. The trip takes 4 minutes. The mass of the lift itself is 500kg.

(a) How much g.p.e does the passenger gain on the way up?

_____

_____ [2]

(b) At what rate (i.e. energy per second) is the passenger gaining g.p.e.?

_____

_____ [2]

(c) At what rate is the lift plus passenger gaining g.p.e.?

_____

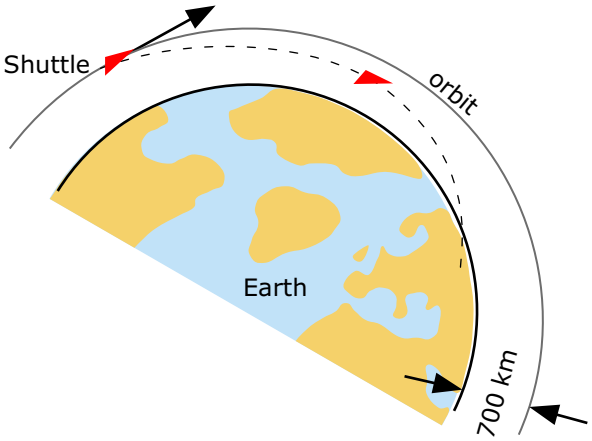
_____ [2]

(d) The motor driving the lift has an efficiency of 25% – at what rate is the motor working while the lift is going up?

_____

_____ [2]

13 A space shuttle orbits the earth 700 km above the surface at a speed of 7500m/s. To return to earth 'falls' out of orbit. It has no engine for most of its descent – it glides. A few minutes later it lands at a speed of 100m/s.



(a) What energy changes take place during the descent?

_____

_____

_____ [2]

(b) What percentage of its energy in orbit is left at touch-down?

(You don't have to know the actual mass of the shuttle to work this out.)

_____

_____ [2]